MTM

THE JOURNAL OF METHODS-TIME MEASUREMENT

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Vol. II

No. 2

In This Issue . . . . .

MTM ASSOCIATION FOR STANDARDS AND RESEARCH

The Journal of Methods-Time Measurement is dedicated to the technical aspects, application developments and general news items concerning the advancement of MTM.

The Journal encompasses the fields of endeavor that were formerly publicized in the MTM Newsletter and MTM Bulletin.

The technical section of the Journal is concerned chiefly with recent research developments both from the established research program at the University of Michigan, Ann Arbor, Michigan, and from somewhat smaller allied projects being conducted throughout the Association membership.

New applications of MTM as well as refinements of established applications are presented in the Application Section to illustrate specific approaches to management problems that can be solved through the use of Methods-Time Measurement.

Current events in the lives of persons associated with MTM are described in the general news section.

The Editorial Staff welcomes contributions for all three sections described.

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MTM

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MTM ASSOCIATION FOR STANDARDS AND RESEARCH

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ANNOUNCEMENT

Now available through the
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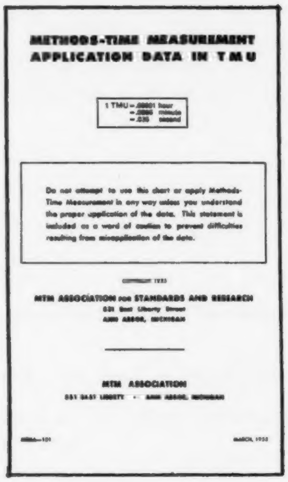
REVISED MTM DATA CARDS



METHODS-TIME MEASUREMENT
APPLICATION DATA IN TMU

Do not attempt to use this chart or apply Methods-Time Measurement in any way unless you understand the proper application of the data. This statement is included as a word of caution to prevent difficulties resulting from misapplication of the data.

MTM ASSOCIATION FOR STANDARDS AND RESEARCH
ANN ARBOR, MICHIGAN

MTM ASSOCIATION

APPLICATION TRAINING SUPPLEMENT*

METHODS—TIME MEASUREMENT

APPLICATION TRAINING SUPPLEMENT

MTM
ASSOCIATION

*This supplement gives a complete
explanation of revised values

Effective with the March-April 1955 issue the price of the Journal is as follows:

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TECHNICAL

FILM ANALYSIS IN MTM

Practitioners of MTM often have need to make use of motion picture film analysis in carrying on their work. As an aid in doing this, the following material is presented in the Journal. It is basically an excerpt from the Association's Research Methods Manual* covering the sections dealing with the filming of operations and the subsequent motion analysis of this film. It has been reproduced here for two major reasons: first, as a general guide to those who may need an instructional guide for the use of motion pictures in their work; and second, so that members of the MTM Association will be better able to contribute to the research activity of the Association by coordinating their filming activity with that of research; thus increasing the amount of usable industrial film available for research analysis.

THE METHOD OF DATA COLLECTION

Any method of collecting research data must meet certain minimum requirements. It must provide sufficiently accurate measurements of the principal dimensions of a motion; time and distance. In addition, it is desirable that it provide secondary information which may be crucial to a particular project such as the motions being performed simultaneously, and the motions preceding and following a motion when performed by the same body member. It should, further, have the general characteristics of providing a complete record that is easily referred to, and of not itself affecting the performance of the work elements by intruding into an operation interference factors that would not be present otherwise.

Though many accurate timing and measuring devices have been used in past research, in all ways the most flexible and simple method which meets all the required conditions best is that of film analysis. The speed at which motions or operations are filmed can be controlled so as to provide sufficiently accurate measuring units for determining performance times for the whole range of work elements as they are now classified. Proper filming angles plus accurate measurement of fixed distances in the field of the camera can provide data for which sufficiently accurate distance estimates can be made. The film, also provides an exact record of exactly what motions or parts of motion are being performed simultaneously and in sequence. The film itself is essentially a permanent record of motions which can be reproduced visually whenever necessary. Finally, since the method does not involve attachments on the operator or the intrusion of additional objects into the workplace, the effect on the operators performance due to the fact that the operation is being recorded will be minimized.

To all these characteristics must be added the portability and ease of handling of film equipment, which is of great importance when the filming of operations must be done in various shops and departments in the field.

The Portion Of An Operation To Be Filmed

How much of an operation should be recorded on film is determined by the requirements of the project. In the case of very general projects such as that of Simultaneous Motions carried on by the Association, it was found advisable to put the complete cycle on film. The requirements of this project made necessary the collection of as many instances of simultaneously performed motions as possible, and such a general requirement made the complete cycle the most efficient thing to use. However, many research projects are confined to a much narrower range of motion types, and it would be of little use to have recorded a whole cycle of an operation when the only desired motions can be found in some small portion of it.

In general, only those portions of an operation containing the desired data need be filmed. The exception to this would be the existence of some additional aim, such as building up a general research film library for later use which would make inclusion of the whole cycle of use. However, one thing should be stressed, the cycle filmed should not be "chopped off" so that the preceding and following motions are not recorded, and the movements of other body members, especially the other hand when hand motions are involved, should be included in the field of the camera. If these things are not done, difficulties will arise in determining such things as limiting motions, or whether a motion is type I or II (in-motion or not).

* A Research Methods Manual, Methods-Time Measurement Research Studies, Report No. 107 available from the MTM Association, 531 East Liberty Street, Ann Arbor, Michigan.

As to how many cycles should be recorded, only a practical rule can be followed. Of course, the larger the quantity of data, the larger the sample and the more valid research results will tend to be. However, practical considerations must limit the number of cycles filmed. Only one point of caution should be made. It is best to avoid filming a very small number of cycles yielding a small amount of data, if the research sample will be derived from only a small range of operations. If the number and range of the operations used is large, of course, the data from a small number of cycles may safely be included in the larger sample.

The Camera Speed

The time length of MTM motions being studied basically determines the camera speed which will provide adequate data for analysis. Operations should always be filmed at a speed which will measure the time length of the motions under study as accurately as possible. If the motions are short in time length, higher speeds should be utilized. Only if the motions under study are relatively long should slower camera speeds be used. As an aid to determining an adequate camera speed the following table has been constructed. It shows the usual standard camera speeds available with commercial silent cameras, and the time interval in TMU's which has elapsed between exposures of a frame of film at each speed.

In general, the fastest speed should be used. However, the measuring unit (the time interval between frame exposures) should be no greater than one-half the time length of the smallest motions being studied and preferably smaller. Whenever motions are being recorded with a measuring unit which may be too large to be accurate, as large a volume of data as possible should be collected. This will, to some degree, overcome the inaccuracies resulting from too large a measuring unit.

Film Speed	Time Elapsed
frames per minute	TMU
1000	$1.66\dot{7}$
2000	.834
4000	.417
960 (16^{fr}/sec)	1.736
1920 (32^{fr}/sec)	.868
3840 (64^{fr}/sec)	.434

By using the present MTM data time values as an indication of the time length of motions, adequate film speeds for the collection of data can be determined. It can be done by merely dividing the MTM time of motions to be studied by the time unit of the film speed being considered. Doing this will indicate the number of frames which will, in general, cover the performance interval of the motions. If the number of frames, i.e., measuring units, is large enough to yield sufficiently accurate measurements, the film speed considered may be used. There is no exact criterion to determine whether the number of frames covering the motion is sufficient. However, as a rule of thumb, it is suggested that the number of frames always be greater than two, if possible. It should be emphasized in addition that if the number of covering frames is small, extra effort to attain a larger volume of data should be made in order that measurement error be reduced.

Background Information

As complete background information as possible on the operator, operation and workplace should be obtained and *recorded*. Same standard type of form should be used for this purpose as it facilitates the finding of information by others and helps to ensure completeness. The Association has used Methods Engineering Council Form 198 with satisfactory results. However, any standardized form is good as long as it covers the pertinent material.

Minimum necessary information indicated by the research experience of the Association is listed below.

1. Operator
   a. Experience
   b. Sex
   c. Age
   d. Weight
   e. Height
   f. Performance Ratings

For research purposes, as many ratings by experienced raters as possible should be obtained at the time of filming the operation. This last ensures an opportunity for the best possible familiarity of the operation by the raters. It is felt that rating an operation from the film alone is less desirable.

2. Operation
   a. Name
   b. Part or Parts
      1) Dimensions
      2) Material
      3) Weight
   c. Hand Tools
      1) Dimensions
      2) Weight
   d. Machinery
      1) Dimensions (when useful)
      2) Speed

3) How operated
e. Descriptions of any part of the operation which may be obscure visually
f. Quality requirements
3. Workplace
a. All possible useful dimensions and distances.[1]
1) Distances between fixed objects and locations.
2) Heights of tables, levers, and handles.

The above outline is only a suggested list. Some items may not be necessary for later analysis of the operation and may be omitted. Others, not included may be needed, and, of course, should be added. Inclusion of any information, even if it does not seem, at the time, to be of any value, is important. Excess material does no harm, and it has been the experience of the Association that crucial bits of information needed later in the analysis of the film were not available because they originally were not included, on the assumption that they would be of little importance. In general, record *all* possible information that time and situation permit, and record it clearly labeled so that it can be identified later by anyone who may make use of the film record of the operation.

Camera Angle

Care should be taken to place the camera in a position which will facilitate the distance estimation which must be made later from the film. This is sometimes difficult to do as a three dimensional activity is being recorded on a two dimensional film strip. It is, of course, impossible to eliminate completely estimation error due to this. The error can be lessened to a great degree by careful placement of the camera. The most useful procedure to follow is to attempt to photograph the motions of the operation from an angle which allow as many of the motions involved to be performed as nearly as possible in a direction which is at a right or 90 degree angle to the camera. Such a procedure will tend to minimize the distance distortion. Figure 1 below, illustrates this graphically.

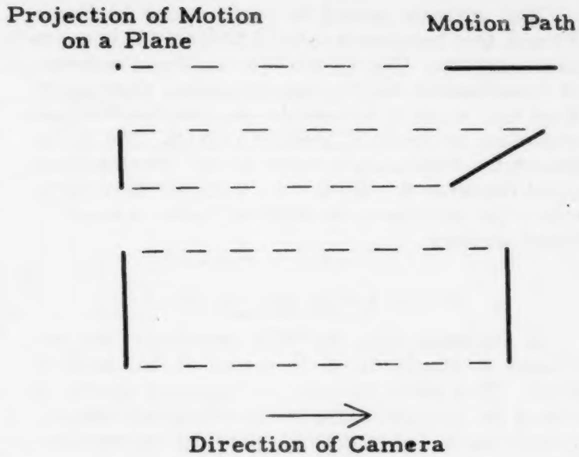


Fig. 1.

As can be seen clearly in this figure the nearer the motions are to being perpendicular to the direction of the camera, the less distorted will be the image of it on film.

In addition, this procedure can be expanded in many instances. Many operations are constructed so that many of the motions performed are performed approximately in a two dimension plane or possibly in two parallel planes. One example of this was encountered in Association research. It concerned the assembly of a valve. The valve body traveled on a moving conveyer which passed in front of the operator. Power tools were suspended over the conveyer, and other tools and parts were positioned next to the conveyer in front of the operator. As the valve moved, the operator performed his operation with motions which were roughly in a vertical plane above the conveyer. The best position for the camera, in this instance, would be one in which the camera direction would be perpendicular to the motion plane, i.e., at a 90 degree angle to the conveyer. Placing the camera this way would again minimize the distance error in a manner similar to that discussed above.

FILM ANALYSIS

It has been found that, for convenience and accuracy, analysing operations from film should be done in specific ways. These are discussed below in the order in which they are performed. In general, it has been found extremely important that the analysis show all motions which are being performed by an operator simultaneously. In most cases this means some form of an operator process chart showing the motions being performed by the body members involved. The only cases where such a chart would not be used would be in special investigations of the qualitative characteristics of a particular type of motion. However, most projects are quantitative in nature and, as will be evident by what follows, the process charts showing simultaneity will yield data which is manipulable quantitatively in terms of most variables affecting the performance of motions.

[1] It is sometimes useful to provide a fixed distance in the field of the camera such as a strip of white tape of a known length.

The analysis should be made frame by frame. Though this becomes a tedious process, it is a very necessary one. Only in this way can the relationship of simultaneous motions be accurately determined. What may seem to be exactly simultaneous motions will often be found to actually overlap, and in research the reason and manner of this overlap are of great importance. In addition, accurate determination of the duration of a motion requires a frame by frame analysis.

Research Film Analysis Sheet

In analysing film, the MTM Association has developed a standardized Research Film Analysis Sheet. This sheet enables the research worker to record the motions being performed simultaneously by both hands, and in addition, provides an additional left and right column for the inclusion of motions of other body members such as the foot.

A typical Research Film Analysis sheet appears in Figure 2. On this sheet, each line represents one frame of the film with the time axis directed downward. The sheet is divided into right and left portions. The columns, as they progress from right and left toward the center of the sheet contain the following information;

1. Description of the motion
2. MTM classification of motion
3. Frame counter number at end of motion
4. Column for indicating duration of motions by body member other than hand
5. Column for indicating duration of motions by the right or left hand.

In addition, a code is used which makes possible the inclusion of other pertinent information and to emphasize the frames where no motion (Hold) or unclassified fumbles occur. This code is as follows:

denotes periods of hold

denotes unclassified fumbles

denotes machine time—the frames between being the time of machine operation.

All of these appear on the sample sheet in Figure 2.

It will be noted that the two columns for motions performed by body members other than the hands are empty in this example. Actually, the machine which is indicated as operating is controlled by a foot pedal. However, the field of the camera included only the movements of the upper part of the body when the film was taken. The foot motion controlling the machine was not visible and, therefore, was not recorded.

This presents a picture of what research film analysis, as done by the Association, consists. The procedure followed in making such an analysis will now be discussed.

Motion Classification

The film was first analysed to break down the operation into MTM elements. At this point all distances were ignored and merely the type and case of motion was determined along with their duration in terms of frames. This last presents the problem of end points and beginning points of these motions. The determination of the ending and beginning points is, of necessity, somewhat arbitrary. However, any reasonable rule, if followed consistently should result in valid and meaningful results. The rule developed and followed in Association research closely follows the procedure used in the original research from which MTM was developed. Briefly, the rule used is shown on p. 31, Figure 2.

Reach, Move and Turn motions were considered as beginning at the frame preceding the frame in which noticeable movement occurs, and as ending in the frame where noticeable motion ceases. With motions where only minor movements occur, the motions were considered as beginning at the frame in which the preceding motion ended, and as ending in the frame preceding the one in which the following motion showed noticeable movement. Note that this ending frame is the same one from which the following motion is considered as beginning. An example will illustrate this rule. In Figure 2 in the right hand on R4B is shown followed by an M2B. In analysis, what would be seen is that the movement of the R4B ceased in frame number 30449 and that the first noticeable movement of the M2B occurred in frame number 30448. Thus the R4B is taken to end in frame 30449 and the M2B is taken to begin at the frame preceding frame 30448 which, of course, is frame 30449. As can be seen on the analysis sheet the division between frames 30449 and 30448 is shown as the dividing point between the two motions.

Using this rule all the motions of the relevant cycles or portions of cycles were classified and recorded. Following this, the research worker along with one or more others familiar with the operations being analyzed went over the doubtful classifications and unsure end points of motions to fix these as accurately as possible.

Distance Estimation

After the classification and duration of motions were determined, the estimation of distances for Reaches and Moves and of degrees turned for Turns was made. To do this the research worker employed the aid of at least one other person familiar.

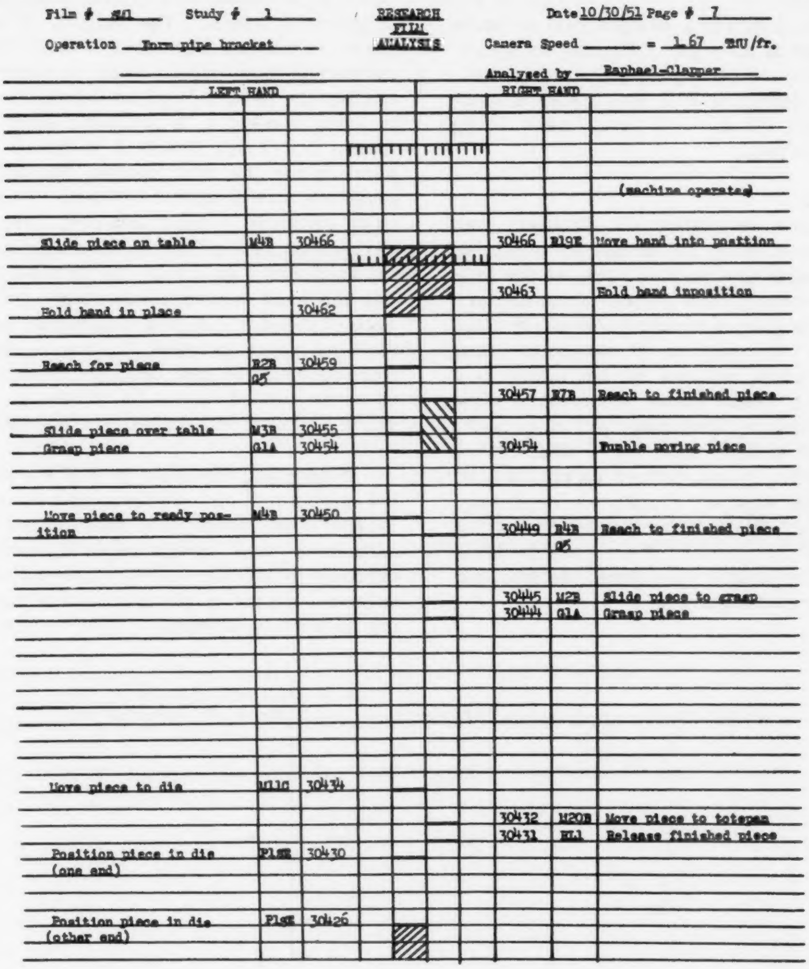


Fig. 2. Research Film Analysis Sheet.

with the operation. This was found to be very important in terms of reducing distance estimation error as much as possible. The method used was to run through each motion at varying speeds and for the estimators to make their estimates independently. If there was reasonably close accord the motion was further examined until a consensus was reached. This distance was then assigned to the motion. If there was no reasonable accord, the motion was given an extremely close examination employing some techniques discussed later, and, if necessary, a revisit to the shop where the operation was performed was made. This was done until a common distance could be agreed upon and assigned to the motion involved. It is important to state that this procedure was followed for each individual motion as motions in the same position in different cycles of the same operation will, in general, not be performed through the same distance. Considering them in this manner, as has been done in the past, introduces an unnecessary error factor which can be eliminated.

Additional Classification and Distance Estimation Aids

In making the motion classifications and distance estimations, certain aids to these processes were employed. They deserve some discussion and explanation in detail.

1. Operation Mock-up

   Since detailed dimensions and positions of objects in the work place were available, the setting up of an equivalent work-place layout was extremely helpful in making more accurate distance estimations.

2. Sample Parts

Whenever possible a sample part or parts were obtained at the time of filming an operation. These were extremely valuable in making motion classifications and distance estimations when the part or parts were being handled or moved.

3. Motion Plots

In distance estimation the problem was often complicated by the difficulty of fixing the whole length of a motion path, as the motion is represented as a series of momentary pictures of the body member involved, in static positions. In addition, it has been found that though many motions do not come to a complete stop, their speed becomes so slow that they cannot be classified as "in motion". The problem arises, then, as to what frame shall the motion be considered as ending and, of course, the ensuing motion as beginning. To overcome these difficulties, frame by frame plot of the position of the body member performing the motion were made. An example of one appears in Figure 3.

Figure 3 would be a typical example of a sequence of plotted motions. The position of the hand in each frame is indicated by an "X". Each "X" is numbered, indicating their proper time sequence. In this example, the hand moved an object to an approximate location coming to a complete stop (frame 2), released the object (frame 2 to frame 3), moved into position for the next motion, *but did not come to a complete stop* (frame 3 to frame 9), and then reached to an object in a fixed location. The hand was observed ending the R6E by slowing down so much that the hand could no longer be considered "in motion". Yet the hand moved continuously into the performance of the R.A. It was impossible to determine the dividing point between the two motions until they were plotted. It then becomes evident that the point of lowest speed would be frame 9, and therefore, would be the most logical point of division.

In addition, Figure 3 presents a completely plotted picture of the distance traversed by the R6E (scaled down, of course) showing the position of the hand in several frames simultaneously. From this distance estimates can be made more easily than by only viewing the performance of a motion as a moving image on a screen.

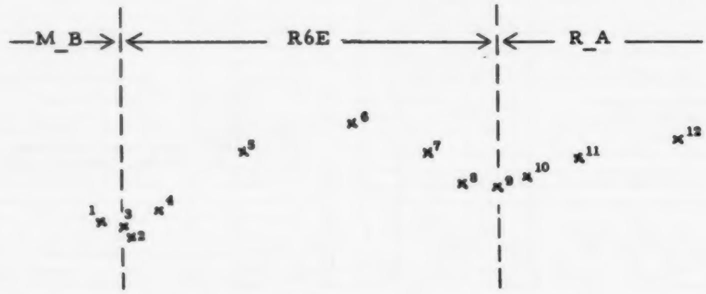


Fig. 3. Frame by Frame Plot of a Motion.

APPLICATION

I

The Editor of the Journal has received many letters commenting on Mr. Clinton Brauer's "Before and After" studies published in the January-February 1955 issue.

Mr. Donald T. Rose of the Industrial Engineering Division, Atlantic Refining Company, has visualized further means to improve the method for Bomb Test of Spark Plug No. 281.

Why can't two testers be used or a tester be developed to accommodate two plugs (the actual test of the plugs might of necessity be performed separately)? "Get and place two plugs, and remove two plugs" could then be performed with the correct simultaneous motion pattern, except in the case of rejects.

The following MTM analysis has been developed by visualizing the operation using a tester which would accommodate two plugs, the actual testing of the two plugs positioned in the tester being performed separately, The advantages of this proposal are a rhythmic operation and a 12% reduction in time.

Further improvements might be realized if:

1. The two positions (P2SE—element 1) could be performed simultaneously.
2. The plugs could be tested simultaneously.
3. The plugs could be positioned simultaneously (P1SE—element 3).

If these improvements could be achieved the time to test a plug would be .0393 minutes.

MTM ELEMENT ANALYSIS

PART Spark Plug PART NO. 281 DEPT.

OPERATION Bomb Test DATE 4-27-55

DESCRIPTION — LEFT HAND	*	MOTION	TMU	MOTION	*	DESCRIPTION — RIGHT HAND
1. GET & PLACE TWO PLUGS IN TESTER						
Reach to plug in tray		R6B	8.6	R6B		Reach to plug in tray.
Grasp plug		G1A	1.7	G1A		Grasp plug
Move plug to tester		M14C	16.9	~~M12B~~		Move plug toward tester.
Regrasp plug		~~G2~~	—			
Plug into tester		P2SE	16.2	G2		
Release plug		~~RL1~~	4.2	M2C		Move plug to tester
Hand away		~~R2E~~	16.2	P2SE		Plug into tester
			1.7	RL1		Release plug
			3.8	R2E		Hand away
			69.3			
2. TEST - ONE PLUG (SAME)			24.3			
3. REMOVE TWO PLUGS & PLACE IN TRAY						
Reach to plug in tester		R6A	7.0	R6A		Reach to plug in tester
Grasp plug		G1A	1.7	G1A		Grasp plug
Remove plug from tester		D1E	4.0	D1E		Remove plug from tester
Plug to tray		M10C	13.5	M8B		Plug toward tray
Regrasp plug during move		~~G2~~	—	~~G2~~		Regrasp plug during move
Position plug in tray		P1SE	5.6			Wait
Release plug		~~RL1~~	4.2	M2C		Plug to tray
		RL1	5.6	P1SE		Position plug in tray
			1.7	RL1		Release plug
(Reach for next plug, 1, above)						(Reach for next plug, 1 - above)
			43.3			
4. REJECT PLUG ASIDE (SAME)			31.0			
5. PLACE TWO TRAYS ON CONVEYOR (Lower Belt)						
Reach for tray (full)		R8B	10.1	R8B		Reach for tray (full)
Grasp "		G1A	1.7	G1A		Grasp "
Tray to conveyor		M14B	14.6	M14B		Tray to conveyor
Release tray		RL1	1.7	RL1		Release tray
			28.1			
6. MOVE TWO EMPTY TRAYS INTO POSITION FOR FILLING						
Reach for tray (empty)		R14B	14.6	R14B		Reach for tray (empty)
Grasp "		G1A	1.7	G1A		Grasp "
Move to position to receive tested plugs		M4B	6.9	M4B		Move to position to receive tested plugs
		RL1	1.7	RL1		
			24.9			

* = LIMITING MOTION FORM NO MTM 3 SHEET OF SHEETS

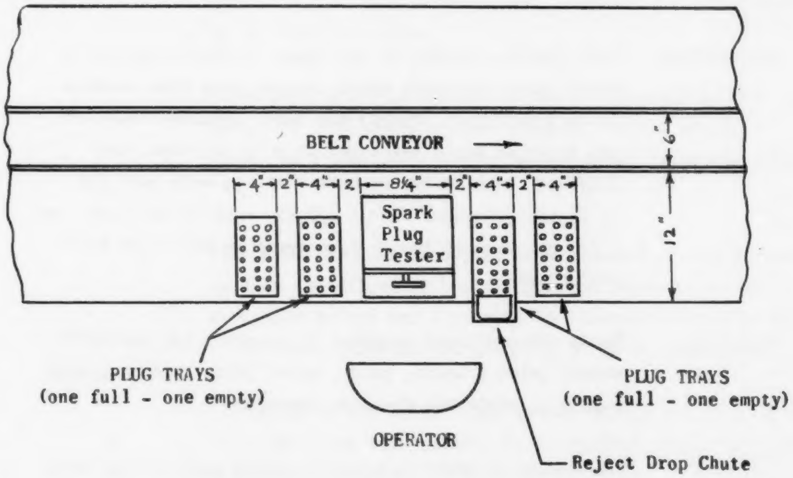
MTM ELEMENT ANALYSIS

PART Spark Plug PART NO. 281 DEPT. ______

OPERATION Bomb Test DATE 4-27-55

DESCRIPTION — LEFT HAND	*	MOTION	TMU	MOTION	*	DESCRIPTION — RIGHT HAND
7. GET TWO TRAYS FROM CONVEYOR (Top belt)						
Reach to tray (full)		R14B	14.4	R14B		Reach to tray (full)
Grasp "		G1A	1.7	G1A		Grasp "
Move to work position		M18B	17.0	M18B		Move to work position
Release		RL1	1.7	RL1		Release
			34.8			

ELEMENT DESCRIPTION	TMU REQUIRED	LEVELED TIME	TIME PLUS 15 % ALLOWANCE	TIME PLUS ALLOWANCE	OCC. PER Plug	TOTAL TIME REQ.
1. Get and place two plugs in tester	69.3	.04158	.04782		1/2	.0239
2. Test one plug	24.3	.01458	.01677		1	.0168
3. Remove two plugs and place in tray	43.3	.02598	.02988		1/2	.0149
4. Reject plug aside	31.0	.01860	.02139		1/20	.0011
5. Place two trays on conveyor	28.1	.01686	.01939		1/42	.0004
6. Move two empty trays into position for filling	24.9	.01494	.01718		1/42	.0004
7. Get two trays from conveyor	34.8	.02088	.02401		1/42	.0006
				TOTAL		.0581



APPLICATION

II

Handpainting operations offer interesting applications of MTM. Basic symbols as used in paint patterns and MTM designations of positions, moves, etc. are included in the following excerpt from a MTM Time Formula Application.

The complete formula is not reproduced. Data given covers the basic patterns, symbols, etc.

Formula - Hand Paint No. 1
August 19, 1953

PART: Rubber Toys and Masks.

OPERATION: Hand Paint.

WORK STATION: Paint line "D."

ALLOWED TIME: $.0000116 \left\{ z\,A + y\,B + x\,C + (w\text{-}v)\,(D + E) + u\,F + t\,G + H + s\,J + r\,K + q\,L \right\}$ hours per piece.

APPLICATION: This formula applies to all types of Hand Painting of Rubber Toys and Masks where no more than five brushes (4 or 5 different colors) are used. Maximum areas of one color of paint are 2 sq. inch in one area, and 1 1/2 sq. inch in two or more areas on each part for 1, 2, or 3 brushes; also 1 1/2 sq. inch in one area, and 1 1/8 sq. inch in two or more areas on each part for 4 or 5 brushes.

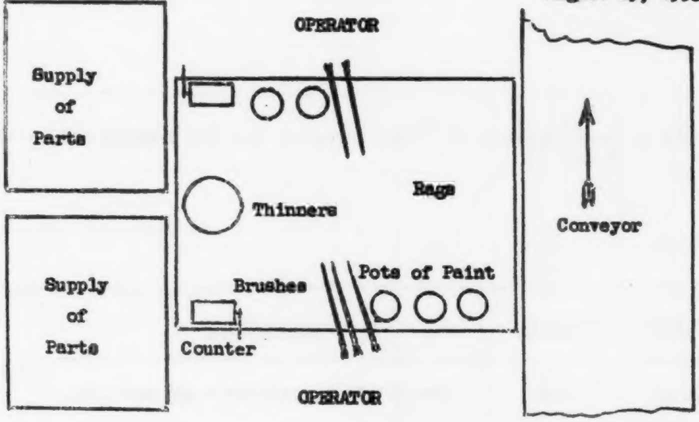
ANALYSIS: Tools and equipment required by operator are worktable, chair, paint brushes, paint, paint pots, thinners, rags, supply of parts and disposal conveyor.

The supply of parts in a carton are brought to the work station by move girl or supervisor, and placed on stand alongside the worktable. A variety of products involve different placings of parts, and layout of worktables involve left and right handed get part and dispose. Some parts are held in the hand and some parts are already resting on a form after spray painting.

Two typical workplaces are shown on the following page: -

APPLICATION II

Formula - Hand Paint No. 1
August 19, 1953



The operator works to a sample and a painting pattern for each Toy, showing number and approximate direction of strokes to cover area to be painted.

The number of parts painted, as recorded on the counter, are used by the operator to fill in a list of work and quantities for payment purposes. This has to be approved by the Line Supervisor.

Where hand paint is applied on top of hand paint, the parts are laid aside on the table in a group of 10 to allow the first paint to dry before applying second paint.

Standards for Hand Painting, as determined by the Formula, include 15% allowance for fatigue and personal and unavoidable delays and a special 1% allowance for filling paint pots, stirring and thinning paint as required.

A regrasp of the brush often occurs during the move to refill the brush with paint. This relieves the tension and pressure of the fingers grasping the brush, and takes place <u>during</u> these M6C moves.

TABLE I—Basic Symbols for Paint Patterns, and MTM Designations of Positions, Moves, etc.

SYMBOL	M.T.M.	DESCRIPTION
- - - - - -	M-C	Move brush to position - not painting.
O	PISE	Position tip of bristles.
X	PISD	Position rest of bristles - e.g. to follow a contour accurately.
———	3M1C 3M2C	Move brush across surface to apply paint - 2 inch maximum length of move (then needs refill of paint). The 3 is multiplier to give longer length of time for this painting move - due to care required to paint along a given contour or line, and partly due to flow of paint from brush preventing rapid movement.
——|	—	End of an M1C painting move where no position required - e.g. running into a previously painted area, or off edge of a projection.

TABLE II - Standard Times For Certain Hand Paint Patterns

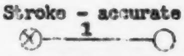
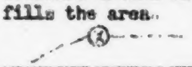
DESCRIPTION AND PATTERN SYMBOL	Group Ref.	M.T.M. Symbols	Time in T.M.U.
1" Stroke - accurate both ends  Narrow enough for one brush stroke	Q1	P1SE P1SD 3M1C P1SE	27.5
2" Stroke - DITTO 	Q2	P1SE P1SD 3M2C P1SE	35.0
 1" Stroke - accurate one end. Usually brush is flexed against surface at start and continues flexed into next move or runs into unimportant end position.	Q3	P1SD 3M1C	16.3
2" Stroke - DITTO 	Q4	P1SD 3M2C	23.8
Single Spot - less than 1/8" diameter 	P1SD	P1SD	11.2
Single Spot - from 1/8" to 1/4" diameter approximate outline only downward motion of bristles fills the area. 	P1SE P1SD	P1SE P1SD	5.6 11.2
Spot or area over 1/4" diameter or where accurate outline is required. Q3 is repeated as many times as required. ("n" times) 	Q1+ nQ3 or Q2+ nQ4	P1SE P1SD 3M1C P1SD n 3M1Cn P1SE	27.5+ n16.3

TABLE III - Symbols and Times for Standard Elements

Symbol	T.M.U.	Element - See Standard Sheets
A	9.3	Operate counter.
B1	41.9	Get part - simple.
B2	53.3	Get part - transfer grasp to position left hand.
B3	56.5	Get part - regrasp and position fingers.
C1	38.0	Get paper from carton - stack for re-use.
C2	30.0	Get paper from carton - dispose to box.
D	20.2	Get brush and prepare to paint.
E	22.5	Release brush on table or pot.
F	50.5	Fill brush with paint.
G	73.3	Clean brush.
H	(From Pattern) (and Table II)	Hand paint to pattern.
J1	15.1	Dispose part - simple
J2	27.7	Dispose part - simple - transfer hands.
J3	46.3	Dispose part - paper under part.
J4	56.1	Dispose Part - paper on top of part.
J5	65.1	Dispose part - paper under and on top.
K1	12.3	Lay aside part to table-simple.
K2	22.1	Lay aside part to table - move fingers and regrasp.
L1	28.0	Get part - simple
L2	42.6	Get part - regrasp and position fingers.

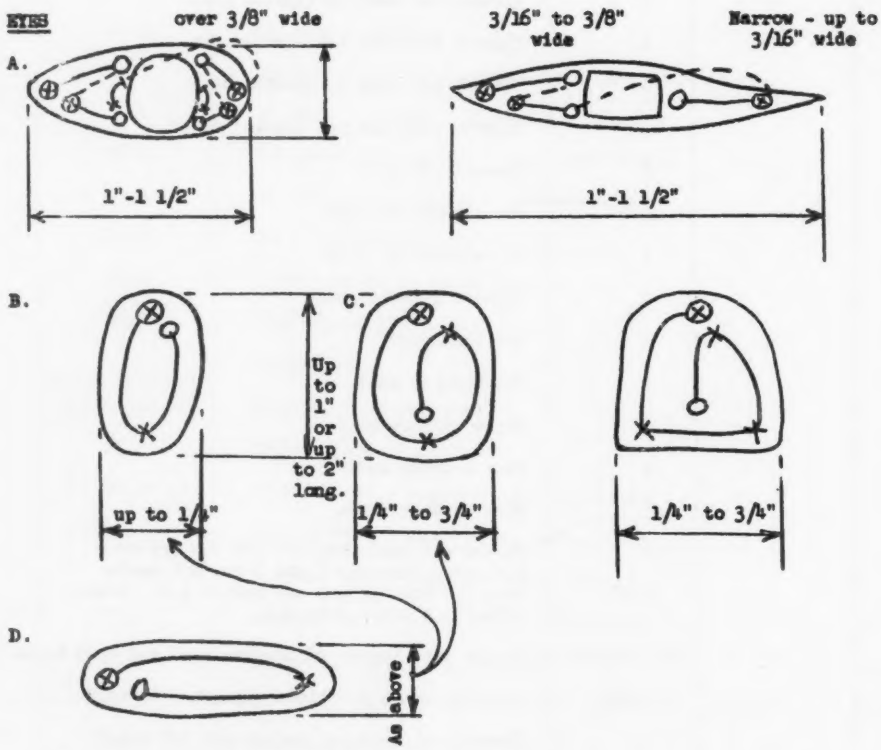
TABLE IV - Multiplying Factor Values

Multiplying Factor	Value	Explanation of Value
Z	0	Element not used or limited out.
	1	Element used and not limited out.
y	0	Element not used or limited out.
	1	Element used and not limited out
x	0	Element not used
	1/6	For element C2 only.
	1	For element G1 only.
	0	Element limited out.
w	1	One brush used.
	2	Two brushes used.
	3	Three brushes used.
	4	Four brushes used.
	5	Five brushes used.
v	0	Factor not used when "r" and "q" are ZERO i.e. when elements K and L are not used.
	9/10	When "r" and "q" are not zero - i.e. when elements K and L are used.
u	See Table V	Varies with number of brushes used and area to be covered.
t	u/300	Once for every 300 times element F is used.
s	0	Element not used or limited out (J1 only)
	1	Element used and not limited out.
r	0	Element not used.
	1	Element used when hand paint on top of hand painting.
q	0	Element not used.
	1	Element used when hand paint on top of hand painting.
n	1 or more	Number of moves in painting pattern.

HAND PAINTING

TYPICAL PATTERNS FOR CERTAIN AREAS

1. EYES



Describe above patterns as: -

A. Position in corner - stroke out - move in - stroke out - fill in.

B. Position at top - stroke down - stroke up.

C. Position at top - stroke down - stroke up - fill in.

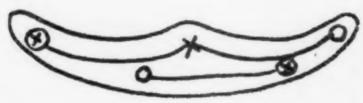
D. Position at corner - stroke across - stroke back.

HAND PAINTING

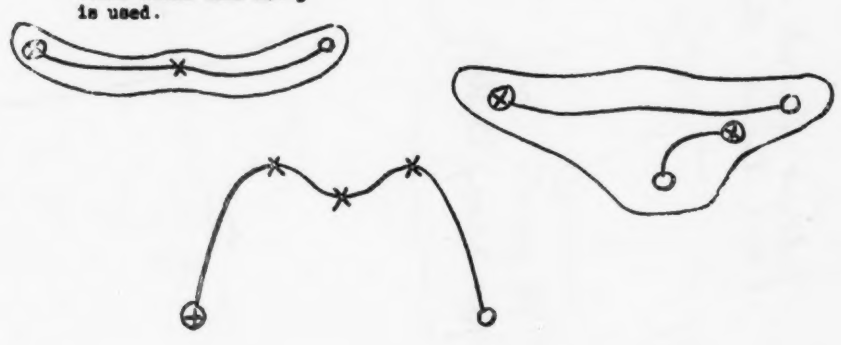
TYPICAL PATTERNS - CONTINUED

2. Lips, Eyebrows, Mustaches, Noses, Scars, etc.

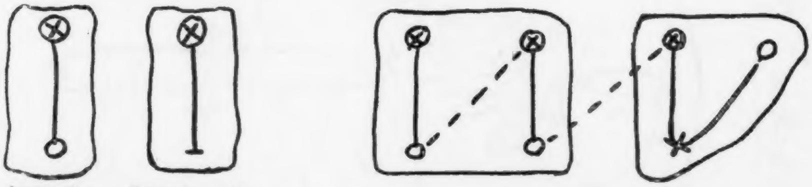
Up to 1/8" wide unless



wider brush than No. 3 is used.



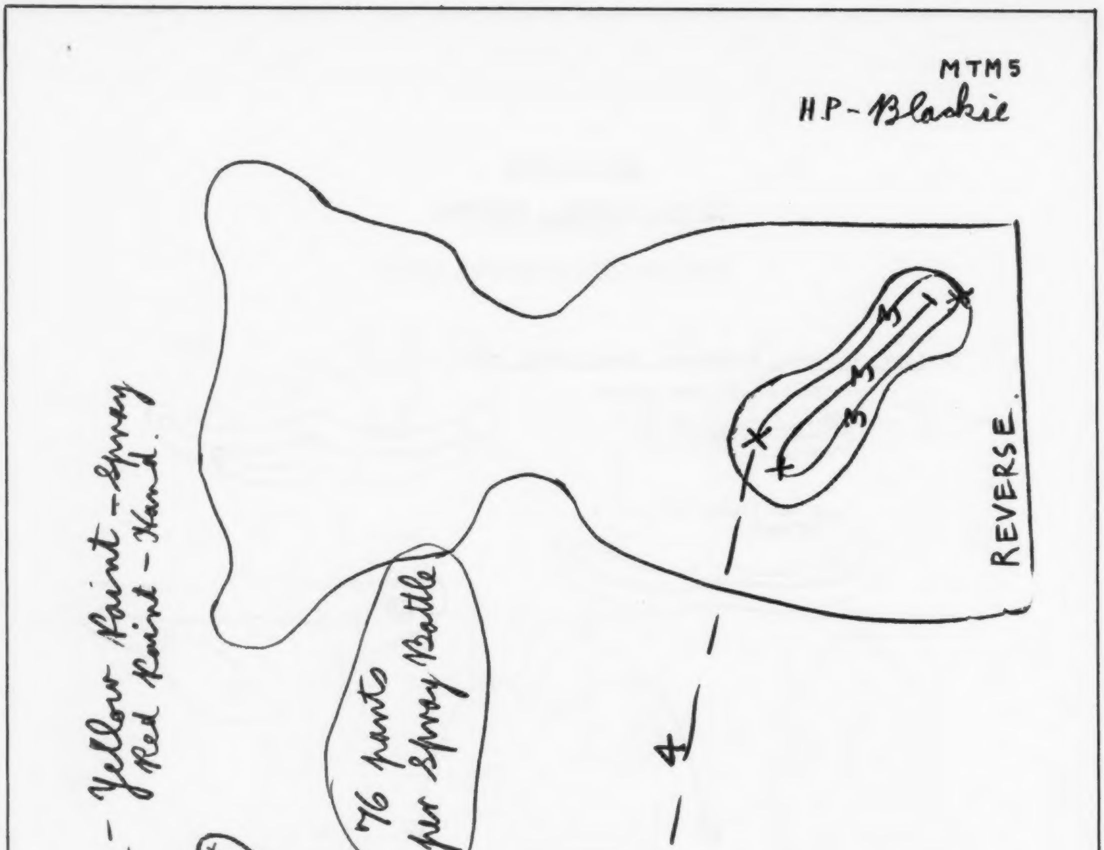
3. Tongues and Fangs, Teeth, etc.

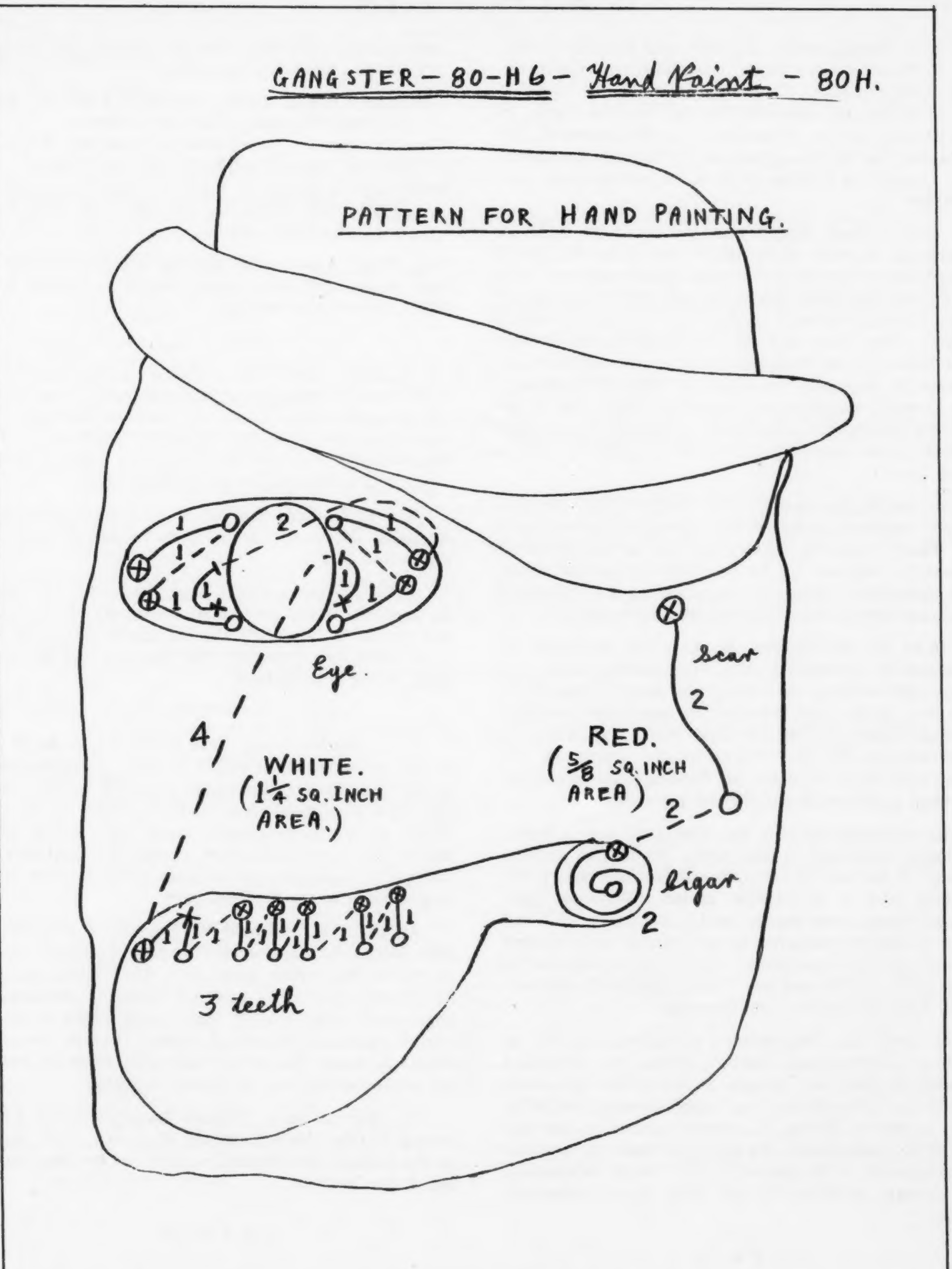


Accurate End

No accurate end; or over edge of moulding

Number of paint strokes depends on width of brush - For No. 3 brush use 1 stroke for each 1/8" width.


MTM5
H.P - Blackie
"Blackie" the Cat - Yellow Paint - Spray
Red Paint - Hand.
76 parts per Spray Bottle
Mouth
FRONT
REVERSE


GANGSTER – 80-H6 – Hand Paint – 80H.
PATTERN FOR HAND PAINTING.
Eye.
Scar
WHITE.
(1 1/4 SQ. INCH
AREA.)
RED.
(5/8 SQ. INCH
AREA)
Cigar
3 teeth

MTM NEWS

G. J. Stegemerten Awarded 1955 Gilbreth Medal. G. J. "Gus" Stegemerten, co-author of "Methods-Time Measurement," has been awarded the 1955 Gilbreth Medal, an international engineering honor, by the Society for the Advancement of Management. Mr. Stegemerten is vice president of Methods Engineering Council, a Pittsburgh firm of management consultants.

The Gilbreth Medal was instituted by SAM 20 years ago in honor of the late Frank Gilbreth, one of the pioneers in time and motion measurement. It is an annual award for distinguished service to the industrial engineering movement in the field of motion study. This year was the first time in its history that two men in the same firm have received it. Harold B. Maynard, president of Methods Engineering Council, was given the medal in 1946. One of the earliest recipients was Herbert Hoover, and other awards have been given to an Englishman and a Canadian.

In making the award, SAM cited Mr. Stegemerten as an "engineer, researcher, author, and consultant" for direct contributions toward the advancement of industrial engineering in the field of motion study and time study, and collaboration in the research work leading to methods-time measurement.

Born in Washington, D. C., and educated at Georgetown University, Mr. Stegemerten early became interested in time study and wage incentives in industry. In the mid-twenties, he was superintendent of wage incentives of the East Pittsburgh works of Westinghouse Electric Corporation. Later he was chief industrial engineer at Westinghouse directing all wage payment standards and policies.

He collaborated with Mr. Maynard, also a Westinghouse employee at that time, in motion picture studies of industrial methods and motions which developed into a procedure called "Methods-Time Measurement" now widely used to set production and wage incentive standards for companies in the United States and other countries. It was first published in book form in 1948 and has been translated into Swedish, Spanish, French, and German.

In 1946, Mr. Stegemerten became an officer in Methods Engineering Council which Mr. Maynard founded in 1934, and helped to launch the practical application of methods-time measurement, or MTM as it is widely known. In recent years, he has directed the installation and administration of methods improvement, work measurement, wage incentives, and product development for many large industrial firms.

* * * * * *

MTM of Ohio Elects Officers. The MTM Association of Ohio, Inc., a Chapter of the International Association, recently elected officers for the year 1955-1956. They are as follows:

President: Lee G. Smith, Industrial Engineer, Baldwin Piano Company, Cincinnati, Ohio.
Vice-President: Henry Bivin, Industrial Engineer, NuTone Chime Company, Cincinnati, Ohio
Secretary-Treasurer: John B. Cecil, Industrial Engineer, Cincinnati Gilbert Machine Tool Company, Cincinnati, Ohio.

The MTM Association extends congratulations and best wishes for the coming year's activities to the MTM Association of Ohio.

* * * * * *

A.I.I.E., Fort Wayne Holds MTM Conference. MTM shared concurrent sessions with a cost reduction program May 5 at Fort Wayne, Indiana. The American Institute of Industrial Engineers, Fort Wayne Chapter conducted the all-day conference with some two hundred persons in attendance.

Mr. D. G. Stohlman, MTM Association Director, keynoted the program on "How to Reach Your Cost Reduction Goal".

MTM speakers on the program were: Mr. David L. Raphael, University of Michigan; Mr. F. H. Bayha and Mr. D. W. Karger, The Magnavox Company; Mr. C. J. Townsley, Capehart-Farnsworth; and Mr. R. F. Stoll, MTM Association.

* * * * * *

Iowa Chapter News. The Central Iowa MTM Association heard Mr. Cecil J. Porter, Chief Engineer at KIOWA Corporation speak March 8 on "Die Casting—How Else Would You Do It?" Some of the high lights of this presentation were die-casting techniques which represent fast, economical methods for fabricating simple and complex shaped parts from raw product to the finished part.

April 12 Mr. Donald W. Herron, Controller of New Monarch Machine & Stamping Company spoke on "MTM Helps New Monarch". Mr. Herron gave an informative review of how his company realized an appreciable reduction in labor costs in the preparation of basement casement window frames for shipment. A change in method suggested by MTM analysis accounted for the reduction in costs.

Mr. Harold Bohn, Factory Manager of the Armstrong Rubber Manufacturing Company, will speak on the subject "MTM and Society", at the May meeting of the Chapter.

* * * * * *

Board of Directors' Meeting. The Board of Directors of the MTM Association will meet May 23, 1955 at the Michigan Union in Ann Arbor, Michigan.

MTM ASSOCIATION FOR STANDARDS AND RESEARCH

MTM REPORTS AND SUPPLIES NOW AVAILABLE

April 15, 1955

I. RESEARCH REPORTS

R.R. 101 Disengage
This report contains a preliminary study of the element disengage. While it is still classified as tentative, the report contains some extremely interesting conclusions on the nature and theory of this element.

R.R. 102 Reading Operations
The first step in the use of MTM for establishing reading time standards is contained in this report. In addition, the report contains a synopsis of the work done in this field by 11 leading authorities.

R.R. 104 MTM Analysis of Performance Rating Systems
A talk presented at the SAM - ASME Time and Motion Study Conference, April 1952. It contains an analysis of performance rating systems and various performance Rating Films from an MTM standpoint.

R.R. 105 Simultaneous Motions
This report represents almost two man-years' work. on a study of Simultaneous Motions. It is a final report of the Simultaneous Motions project undertaken by the MTM Association. While it does not purport to provide complete and exhaustive answers to all problems in the field of Simultaneous Motions, it presents a great deal of new and valuable information which should be of interest to every MTM practitioner.

R.R. 106 Short Reaches and Moves
This report contains an analysis of the characteristics of Reaches and Moves at very short distances. It develops important conclusions concerning the application of MTM to operations involving these short distance elements.

R.R. 107 A Research Methods Manual
The research activity of the Association has developed an effective and comprehensive set of methods for carrying on research in human motions. This report details the major techniques used. Adequate sources of motion data, film analysis, data recording, and statistical methods of analysis are among the topics discussed.

R.R. 108 A Study of Arm Movements Involving Weight
In this report, the results of a large investigation into the effect of weight on the performance times of arm movements are presented. While more effective means of determining correct time allowances for moving weights are given, the comprehensvie discussion of the whole area of weight phenomena is probably of more fundamental importance. The effect of such conditions of performance as the use of one or two hands, sliding vs. spatial movements, and male and female performance are among the topics presented.

II. APPLICATION TRAINING SUPPLEMENT — March, 1955 issue
The MTM Training Supplements are recommended as the minimum text and data for application training course instruction in the areas of Reading, Disengage, Grasp, Release, Short Reaches and Moves, and Move with Weight. The Supplements provide an explanation of the revised data card values.

III. PROCEEDINGS — INTERNATIONAL MTM CONFERENCES
A complete copy of each speaker's presentation at the conferences, including charts and diagrams for the years 1952, 1953 and 1954.

IV. JOURNAL OF METHODS TIME MEASUREMENT *
The *Journal* is dedicated to the technical aspects, application developments and general news items concerning the advancement of MTM.
* *Use separate subscription blank.*

V. DATA CARDS

A. Detailed Data Card (MTMA 101)—two pages, hinged, containing complete data and definitions. Available in paper and on plastic. Size about 7½ x 9 flat or 7½ x 4½ folded.

B. Simplified Data Card (MTMA 201)—single wallet-size card, containing only the simplified MTM data. Available in paper only.

C. Condensed Data Card (MTMA 301)—single card containing complete time values, but without definitions. For the advanced practitioner only. Available in plastic only. Since about 3¾ x 5¾.

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over 1000	.10	.90	.55	.07

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(See next page for Order Blank.)

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